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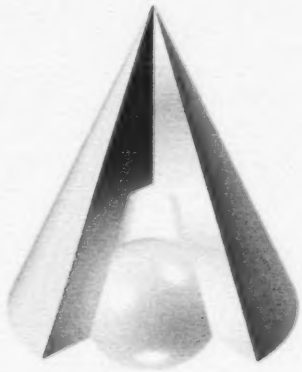
The Effects of Education on Canadians' Retirement Savings Behaviour



by Derek Messacar

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..	not available for a specific reference period
...	not applicable
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0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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by

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Social Analysis and Modelling Division
Statistics Canada

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Table of contents

Abstract **5**

Executive summary **6**

1 Introduction **7**

2 Data and sample selection **9**

2.1 Datasets 9

2.2 Sample selection 10

3 Descriptive analysis **11**

3.1 Education and wealth accumulation 11

3.2 Education and financial literacy 15

4 The effect of education on savings rates **17**

4.1 Exogenous variation in education 17

4.2 Returns to education 20

5 The effect of education on savings adjustments **21**

5.1 Savings nudge 22

5.2 Results 23

6 Conclusion **29**

References **30**

Abstract

This paper assesses the extent to which education affects how Canadians save and accumulate wealth for retirement. The paper makes three contributions. First, a descriptive analysis is presented of differences in savings and home values across individuals based on their levels of educational attainment. To this end, new datasets that link survey respondents from the 1991 and 2006 censuses of Canada to their administrative tax records are used. These data provide a unique opportunity to jointly observe education, savings, home values, and a plethora of other factors of relevance. The data show that both savings and home values increase with the highest level of schooling attained. Second, the causal effect of high school completion on savings rates in tax-preferred accounts is estimated, exploiting compulsory schooling reforms in the identification. The analysis indicates that high school completion boosts retirement savings rates by 2 to 6 percentage points annually, even after controlling for income and many other factors that may indirectly affect this result. Third, building on a recent study by Messacar (2015), education is also found to affect how individuals re-optimize their savings rates in response to an automatic change in pension wealth accumulation. Overall, individuals with lower levels of education are found to save less for retirement than those with higher levels of education but to benefit from an automatic pension contribution by remaining passive, whereas those with higher levels of education respond to the distortion by actively adjusting contributions across savings vehicles at relatively low cost. The implications of this study's findings for the "nudge paradigm" in behavioural economics are discussed.

Keywords: workplace pension; retirement savings; crowd-out; education; compulsory schooling; nudge paradigm; regression kink design; instrumental variables.

Executive summary

Using two new datasets that link survey respondents from the 1991 and 2006 censuses of Canada to administrative tax records, this paper assesses the extent to which education affects how Canadians save and accumulate wealth for retirement.

First, using descriptive analysis, this study finds the following:

1. Across groups of individuals based on their highest level of schooling attained—high school dropouts, terminal high school diploma or trades certificate, some postsecondary education, and university graduate—individuals with more schooling are more likely to contribute to a tax-preferred savings account and to have higher savings rates in these accounts over the life cycle than those with less schooling.

2. Similarly, home values at a given age increase with educational attainment, and the likelihood of renting housing decreases with educational attainment.

Second, this paper extends the descriptive analysis by estimating the causal effect of education on retirement savings rates, exploiting compulsory schooling reforms as an exogenous source of variation in education to identify this effect. This analysis shows the following:

3. Controlling for demographics, income, health, and other channels through which education indirectly affects savings decisions, high school completion boosts retirement savings rates by 2 to 6 percentage points annually over the life cycle.

Third, education is shown to affect how individuals re-optimize their savings rates in response to an automatic change in pension contributions to employer-sponsored accounts. Specifically, the analysis builds on a recent study by Messacar (2015) and shows the following:

4. Workers with lower levels of schooling are unresponsive to an automatic employer pension contribution. For this group, an exogenous increase in workplace pension contributions effectively increases total retirement savings.
5. In contrast, workers with higher levels of education actively crowd out an automatic contribution by reducing how much they save in other retirement savings plans.

Taken together, these results indicate that individuals with lower levels of education save less for retirement than those with higher levels of education but benefit from an automatic contribution by remaining passive, whereas those with higher levels of education adjust savings across vehicles in response to an automatic contribution at low cost. The implications of this study's findings for the "nudge paradigm" in behavioural economics are discussed.

1 Introduction

There is a large literature in economics that estimates the returns to education. Previous studies have found that staying in school longer can lead to higher labour market income; lower rates of substance abuse, incarcerations, and criminal activity; better health and happiness; and longer life expectancy (Mensch and Kandel 1988; Angrist and Krueger 1991; Lochner and Moretti 2004; Oreopoulos 2006, 2007; van Kippersluis, O'Donnell and van Doorslaer 2011). However, the extent to which education affects how individuals prepare for retirement is an underexplored empirical issue. A better understanding of whether schooling affects savings and wealth outcomes would provide new insight into the long-run returns to education.

The objective of this paper is to fill the gap in this literature by assessing the extent to which education affects how Canadians save and accumulate wealth for retirement. To this end, the analysis uses new datasets that link survey respondents from the 1991 and 2006 censuses of Canada to their administrative tax records, providing a unique opportunity to simultaneously observe schooling, retirement savings and reported home values of individuals, as well as many other demographic, income, and personal characteristics of relevance.

In particular, this paper makes three contributions. First, to motivate the study, a descriptive analysis of differences in savings and home values across individuals by educational attainment, is presented. The data show that savings and home values both increase when the highest level of schooling attained increases.

Second, to control for the possibility that individuals' education and savings decisions are correlated for unobserved reasons, the causal effect of completing high school on savings rates in tax-preferred accounts is estimated in a quasi-experimental design. Specifically, as in the returns-to-education literature, historical reforms to compulsory schooling laws across provinces are used in an instrumental variables (IV) framework as a source of exogenous variation in education to credibly identify this effect (Acemoglu and Angrist 2000; Milligan, Moretti and Oreopoulos 2004; Oreopoulos 2006). The results show that, for individuals who complete high school, savings rates are higher by approximately 2 to 6 percentage points annually, an effect that persists remarkably over the life cycle. As before, this finding is robust to controlling for a wide set of channels through which education may indirectly affect savings, including family composition, income, permanent income, home values, and health.

Third, this paper investigates whether education affects how individuals respond to an automatic pension contribution (a savings "nudge") in terms of their levels of saving across tax-preferred accounts. Put differently, while the first two contributions look at how schooling influences initial savings rates, the third contribution is to consider whether schooling affects how individuals re-optimize their savings after an exogenous change in initial savings rates. In a recent study, Messacar (2015) estimates that a nudge of $1.00 by employers into registered pension plans (RPPs) crowds out workers' savings in registered retirement savings plans (RRSPs) by $0.55, among workers earning close to the average industrial wage. That study also shows that there is substantial heterogeneity in how workers respond to a nudge based on their savings histories. Workers who use tax-preferred accounts regularly offset a nudge by reducing other savings, whereas infrequent savers are unresponsive to the distortion. With this result in mind, coupled with the fact that education affects initial savings rates, this paper extends Messacar's (2015) crowd-out analysis to assess whether the observed heterogeneity can be explained by educational attainment. Compulsory schooling reforms are used again in the identification to separate the effect of learning from sorting. The results show that workers with higher levels of education both save more in tax-preferred accounts and actively re-optimize contributions across accounts in response to a nudge. In contrast, those with lower levels of schooling save less for retirement but are passive to a nudge; for them, the savings distortion has the effect of passing through into greater total retirement wealth accumulation.

This study contributes to several related literatures. In addition to the studies cited above on the returns to education, more schooling has been found to increase financial literacy, stock-market participation and returns, diversification, and the use of financial planners (Calvet, Campbell and Sodini 2009; Lusardi and Mitchell 2010; Mullock and Turcotte 2012; Lusardi, Michaud and Mitchell 2013). In addition, Venti and Wise (2014) show that high school completion affects individuals' take-up of Social Security Disability Insurance and retirement benefits in the United States. This study is the first to directly estimate the effect of education on savings and wealth accumulation decisions leading up to retirement. Further, the extent to which employer-sponsored pension plans raise or redistribute net savings is an unresolved issue. Some studies estimate that these plans boost savings (Poterba, Venti and Wise 1994; Venti and Wise 1996; Gelber 2011), while others show that workplace pensions largely crowd out contributions in other plans (Engen and Gale 1994; Gale 1998; Veall 2001; Benjamin 2003). The lack of consensus may stem from differences in the data or research designs used (Bernheim 2002). While prior research has established that some savers actively respond to a nudge whereas others are passive (Chetty et al. 2014; Messacar 2015), this analysis is the first to find that education is a determinant of such heterogeneity. Hence, active versus passive choice at least partly results from human-capital traits that are amenable to change through education policy. This finding contributes to the nudge paradigm of Thaler and Sunstein (2008) by providing new insight into the cognitive mechanisms behind why a nudge works, an issue that is not well understood (Bernheim, Fradkin and Popov 2015). The results are also consistent with an emerging literature on savings decisions with limited rationality (Sethi-Iyengar, Huberman and Jiang 2004; Choi, Laibson and Madrian 2011; Beshears et al. 2013).

The paper proceeds as follows. The next section describes the datasets and sample selection used in this study. Then, Section 3 presents a descriptive analysis of the differences in savings rates and home values by educational attainment. The causal effects of education on savings rates and on savings adjustments to a nudge using the IV estimator are shown in Sections 4 and 5, respectively. Section 6 concludes with a summary of the findings and a short discussion of their resulting implications for behavioural economics.

2 Data and sample selection

This section begins by describing the primary datasets used in this study. Then, the sample selection imposed on the data is outlined.

2.1 Datasets

Two datasets that combine income-tax information from administrative records with information on education and home values from Canadian census responses are used in this study.

The first dataset is a linkage of the Longitudinal Worker File (LWF) and the 1991 Census (the "LWF–1991 Census" file). The LWF is an administrative dataset designed to provide information on employment dynamics in Canada, and consists of a 10% random sample of workers. The data based on personal income-tax records are collected by Canada's central tax authorities and contain rich information about demographics, employment, income, taxes, allowances and savings for the individuals represented.[1] In addition, the 1991 Census data provide information on the highest level of educational attainment of respondents and details about their living arrangements, including home value, whether a mortgage is present and whether their housing is rented. Because the 1991 Census is a 20% national sample, the LWF–1991 Census file is approximately a 2% sample of tax filers.[2] Other studies that have used this dataset include Wilkins et al. (2008), Frenette (2014*a*, 2014*b*), and Ostrovsky and Frenette (2014).

The second dataset used in this study is a linkage between the T1 Personal Master File (T1PMF), the 2006 Census, and the 2011 National Household Survey (NHS) (the "T1PMF–2006 Census–2011 NHS" file). These data provide much of the same information from personal income-tax records as the LWF–1991 Census file, and information on education and living arrangements continues to be available from the 2006 Census responses.[3] In total, the data are based on the tax data and survey responses of approximately 850,000 individuals who were successfully linked across the three files. A prior study that uses this file and provides further information on the linkage process is Frank, Frenette and Morissette (2015).

To implement this study, the LWF–1991 Census file and the T1PMF–2006 Census–2011 NHS file are stacked together using only the relevant variables that are common to both datasets. The following variables from administrative records are used: age, sex, marital status, labour income, union dues, total income, disability tax allowances, contributions to and withdrawals from RRSPs, and contributions to RPPs.[4] In addition, the following variables from the census are used: province of birth, highest level of educational attainment, home value, presence of a mortgage, and use of rental housing. The administrative data are longitudinal, spanning the years 1991 to 2010, whereas the census data correspond to the 1991 and 2006 cross-sections. Other variables on compulsory schooling laws and related institutional factors are from Oreopoulos (2006) and are described in more detail below.

1. The central tax authorities are Revenu Québec in the province of Quebec and the Canada Revenue Agency for all the other provinces and territories.
2. The sample size is slightly smaller than 2% (around 1.5%), because the sample is restricted to individuals aged 25 or older, resulting in the loss of approximately 25% of the population.
3. To ensure comparability of the education responses between the LWF–1991 Census file and the T1PMF–2006 Census–2011 NHS file, only the information collected from the 2006 Census is used from the latter file.
4. The variable used as a proxy for RPP contributions is the pension adjustment (PA). The PA is a measure of savings in employer-sponsored accounts, which includes contributions to RPPs, deferred profit-sharing plans, and some unregistered accounts, although the last two types of account are relatively uncommon. For further discussion, see Morissette and Ostrovsky (2006).

2.2 Sample selection

The following sample restrictions are imposed. First, the analysis is restricted to individuals aged 20 to 59 to focus on savings behaviour over the life cycle prior to retirement (the earliest age at which individuals can start collecting income from the Canada Pension Plan [CPP] or the Quebec Pension Plan [QPP] is 60). Second, individuals must have been born in a Canadian province, according to their census responses, which means individuals born in a territory and immigrants are excluded. This restriction is necessary for matching individuals to the compulsory schooling laws they most likely faced as students based on their province of birth; this methodology is also used throughout the related literature cited above. Third, individuals must have positive labour income, given that RRSP and pension adjustment eligibility are conditional on having such income. Since the LWF is a representative sample of workers and the analysis centres on individuals below the minimum age for retirement, more than 95% of the sample is observed with labour income at least once.

Table 1 presents summary statistics for this sample. On average, individuals are 41.6 years old and are divided almost evenly between men and women, and 65.6% are married or in common-law relationships. In the sample, 66.4% of individuals have income from at least one source other than employment, and 0.4% claim a disability tax credit. The averages of income from employment and from other sources are $49,200 and $9,150, respectively, conditional on these values being positive. "Other income" is calculated as total income less labour income.

Table 1
Summary statistics of sample

Statistics	Mean	Percentile		
		25th	50th	75th
		years		
Demographics				
Age	41.6	34.0	43.0	50.0
		percent		
Female	49.5	...	...	...
Male	50.5	...	...	...
Married or in a common-law relationship	65.6	...	...	...
Employment and income				
Has labour income	100.0	...	...	...
Has other income	66.4	...	...	...
Other characteristics				
Has disability allowances	0.4	...	...	...
		2010 constant dollars		
Conditional income				
Labour income	49,200	20,100	41,550	65,950
Other income	9,150	550	2,550	8,550

... not applicable

Notes: "Other income" is defined as total income less labour income. The conditional dollar values for labour income and other income refer to the values conditional on being strictly positive.

Sources: Statistics Canada, Longitudinal Worker File—1991 Census and T1 Personal Master File—2006 Census—2011 National Household Survey.

3 Descriptive analysis

This section begins by assessing the correlations between educational attainment and various measures of savings and wealth accumulation. Then, to complement the remainder of the analysis, the link between education and financial literacy is investigated using data from the 2009 Canadian Financial Capability Survey (CFCS).

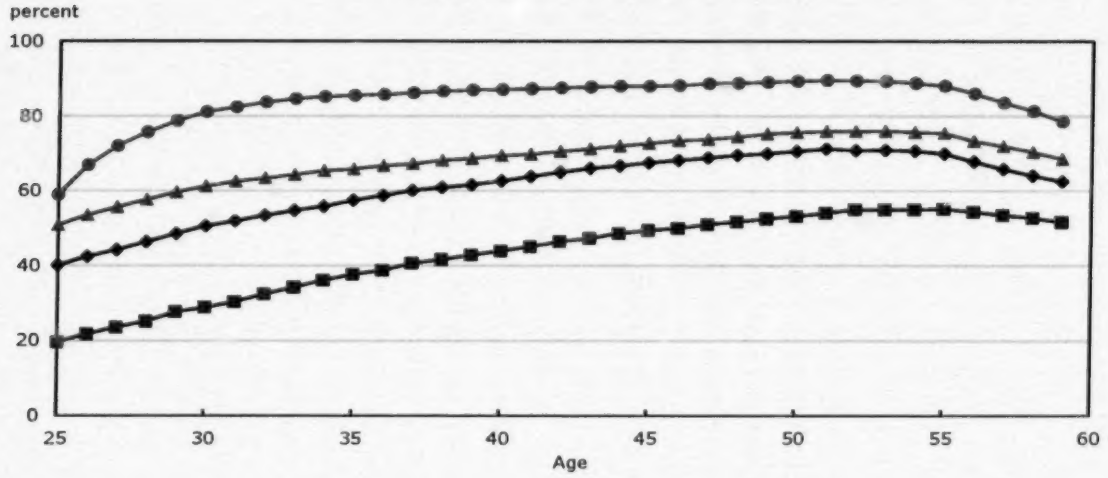
3.1 Education and wealth accumulation

In Chart 1, Panel A begins by showing the incidence of contributing to an RPP or RRSP at various ages. Individuals with a terminal high school diploma or a trades certificate are grouped together because their savings patterns are similar.[5] The results indicate that individuals with higher reported levels of schooling are more likely to save in tax-preferred accounts than individuals with lower levels of educational attainment. Many factors are likely to drive these results. For example, more schooling can raise permanent income and affect the types of jobs held (including workplace pension coverage), health, family characteristics and life expectancy—all of which affect the demand for savings.

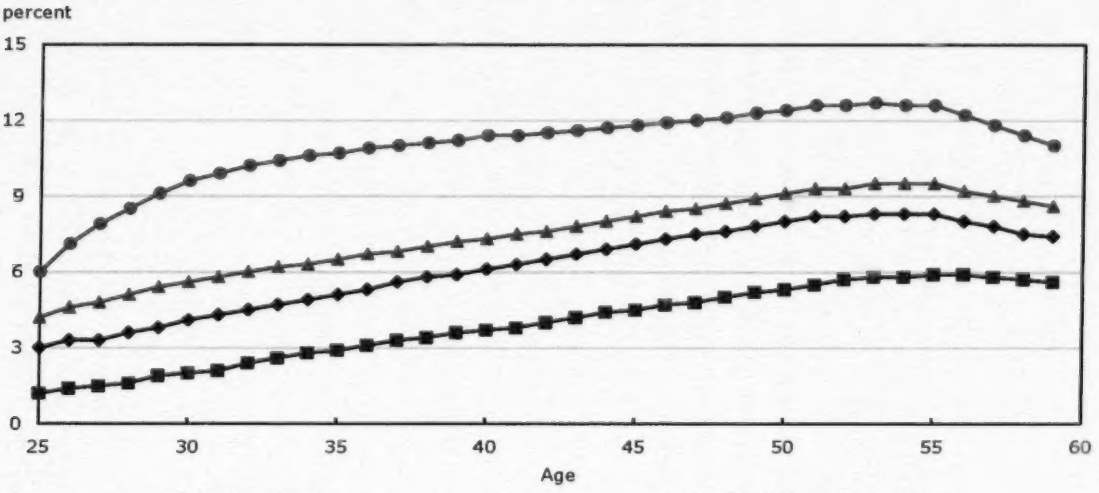
5. Following Frenette (2014*b*), individuals with a terminal high school diploma are defined as those who had obtained a high school diploma but not any postsecondary education by the 1991 Census or the 2006 Census.

Chart 1
Use of tax-preferred savings accounts over the life cycle, by educational attainment

Panel A — Incidence of contributing to a tax-preferred savings account, by educational attainment



Panel B — Net savings rates in tax-preferred savings accounts, by educational attainment



Notes: Panel A shows the likelihood of contributing to a tax-preferred savings account (registered pension plan [RPP] or registered retirement savings plan [RRSP]) at a given age, from 25 to 59, for several groups based on their educational attainment. Panel B shows the net savings rates for each group. The net savings rate is defined as RRSP contributions less withdrawals plus RPP contributions in the year. Following M. Frenette (2014*b*, *The Long-term Labour Market Premiums Associated with a Terminal High School Diploma*), individuals with a terminal high school diploma are defined as those who had obtained a high school diploma but had not acquired any postsecondary education by the 1991 Census or the 2006 Census.
Sources: Statistics Canada, Longitudinal Worker File–1991 Census and T1 Personal Master File–2006 Census–2011 National Household Survey.

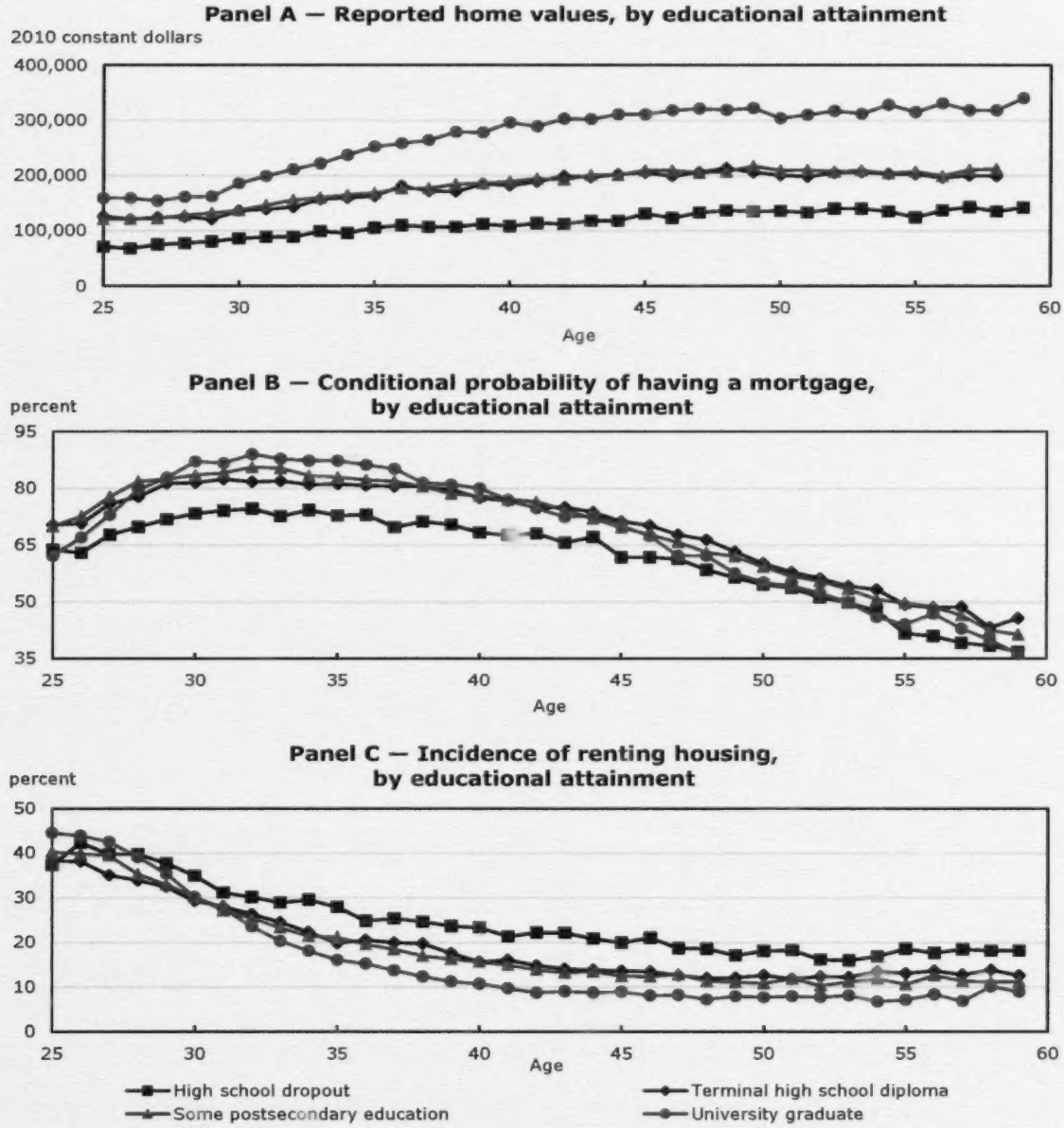
Similarly, Panel B in Chart 1 shows that savings rates in tax-preferred accounts also increase with educational attainment. Based on the fact that RPP and RRSP eligibility are conditional on labour income, the savings rate is calculated here as net contributions to RPPs and RRSPs (i.e.,

contributions less withdrawals) relative to labour income.[6] This definition is also used in related studies, such as Chetty et al. (2014). The finding that more schooling leads to higher savings rates even at early ages, coupled with the fact that this effect appears to persist remarkably over the life cycle, suggests there are large cumulative returns to education on retirement preparedness, consistent with prior research (Venti and Wise 2014).

To explore the effects of education on other forms of wealth accumulation, Panel A in Chart 2 plots individuals' average home values in 1991 or 2006 (expressed in 2010 constant dollars) at various ages. Note that the home value is a measure of the asking price of the home for owner-occupied residences and is not net of mortgage balances outstanding, such that this variable is not a direct measure of current net housing wealth. The results show that home values grow over the life cycle, notably from around age 30 to 40, and that values increase with educational attainment. Panel B shows that the likelihood of having a mortgage, conditional on having a strictly positive home value, increases with educational attainment, but this effect is most likely driven by selection into home ownership. The likelihood of renting housing is found to decrease with educational attainment, as shown in Panel C.

6. Since the savings rate is a constructed variable, this measure is bottom-coded at 0 and top-coded at 18% of labour income to control for erroneous calculations or extreme values. This upper bound was chosen because individuals' maximum annual contribution limits for RPPs and RRSPs are based on 18% of labour income. In reality, individuals may contribute above this threshold in a given year, because unused contribution room carries forward indefinitely. However, for the purpose of this study—which focuses on retirement savings averaged over the life cycle—this upper bound is a reasonable threshold. In addition, the actual distribution of savings rates before top-coding exhibits a large bunching response at 18% of labour income (not shown).

Chart 2
Home equity accumulation over the life cycle, by educational attainment



Notes: Panel A shows the average value of the home reported in the 1991 and 2006 censuses at a given age, from 25 to 59, for several groups based on their educational attainment. Panel B shows the probability of having a mortgage, conditional on a strictly positive home equity value, for each group. Panel C shows the incidence of renting housing for each group. Following M. Frenette (2014*b, The Long-term Labour Market Premiums Associated with a Terminal High School Diploma*), individuals with a terminal high school diploma are defined as those who had obtained a high school diploma but had not acquired any postsecondary education by the 1991 Census or the 2006 Census.
Sources: Statistics Canada, Longitudinal Worker File–1991 Census and T1 Personal Master File–2006 Census–2011 National Household Survey.

3.2 Education and financial literacy

While many factors contribute to these observed differences across groups, it is instructive to consider whether financial literacy—an understanding of financial concepts—plays a role. To this end, data from the 2009 CFCS are used to assess how financial literacy varies with education. The survey asked respondents several questions designed to measure their knowledge of key financial issues, including how inflation affects the future value of savings, the type of taxation charged on different types of savings, and the relative risks of different savings options. In total, respondents answered 14 questions on these and related issues, and answers to these questions were used to construct an overall financial literacy score based on the percentage of correct responses. The survey questions, correct responses, and distribution of respondents' test scores are further described by Mullock and Turcotte (2012). Other studies that have used these data to assess literacy or financial well-being include Schellenberg and Ostrovsky (2010), Keown (2011), LaRochelle-Côté and Uppal (2011), and Luong (2011).

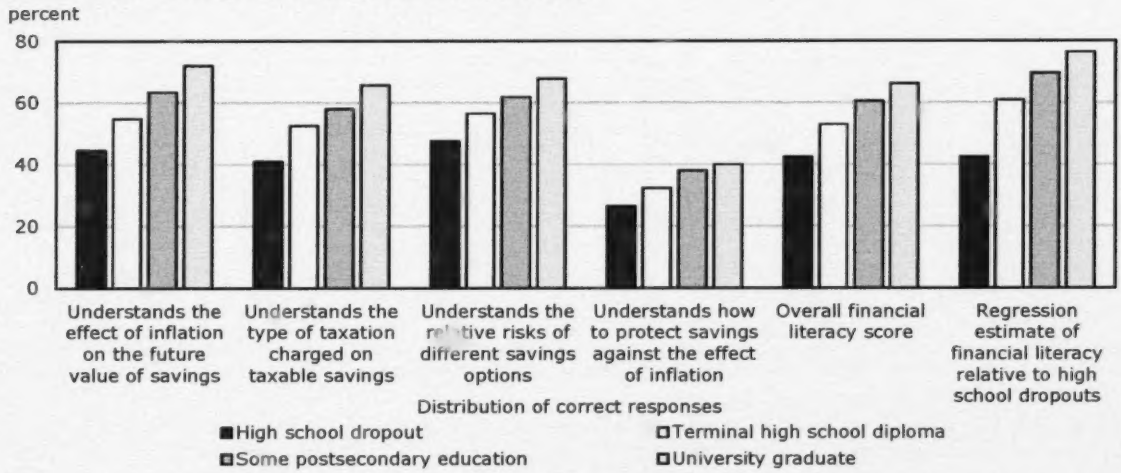
Chart 3 illustrates how individuals' financial literacy varies by educational attainment. In particular, individuals with more schooling score higher across all measures than those with less schooling. To assess the extent to which these differences are explained by other observed factors, the following statistical model is estimated:

$$Literacy_i = \alpha + \beta HSGrad_i + \gamma SomePSE_i + \delta UnivGrad_i + X_i'\zeta + \epsilon_i. \quad (1)$$

The dependent variable in Equation (1), $Literacy_i$, is individual i 's overall financial literacy score, defined above. The variable $HSGrad_i$ is an indicator of whether the respondent has a terminal high school diploma, which takes the value of "1" if the highest reported level of schooling attained is high school and "0" otherwise. Similarly, $SomePSE_i$ and $UnivGrad_i$ indicate whether the individual's highest educational attainment is some postsecondary education and a university degree, respectively.[7] Hence, β captures the average differential in financial literacy between a high school graduate and the comparison group—high school dropouts—after controlling linearly for the vector of other factors X_i that vary across individuals that could also influence the outcome measure. These variables include: the age, sex, and marital status of the respondent; whether the respondent's family uses a credit card and has a financial budget; housing tenure; years left on the mortgage; whether the respondent will be financially prepared to retire; the value of financial assets and debts; and the respondent's personal and household incomes. The equivalent differentials for obtaining some postsecondary education and graduating from university relative to the comparison group are γ and δ, respectively. The variable ϵ_i captures the model's statistical residual.

7. The 1991 and 2006 censuses of Canada rank educational attainment using a labour-market-based approach. For example, individuals who did not graduate from high school but who went on to complete some vocational training are regarded as having some postsecondary education—a higher level of schooling than that attained by individuals with a terminal high school diploma—on the basis that vocational training is a qualification obtained primarily for employment, whereas high school is not. From the census responses, identifying whether individuals completed high school before obtaining postsecondary education is not possible. This issue is important for the following reason. In Sections 4 and 5 of this paper, individuals are sorted according to whether they obtained at least a high school education, evaluated using the labour-market-based ranking. Some individuals with "at least" high school may not have actually received a high school diploma if they went on to obtain some postsecondary education.

Chart 3
Financial literacy, by educational attainment


percent
80
60
40
20
0
Understands the effect of inflation on the future value of savings
Understands the type of taxation charged on taxable savings
Understands the relative risks of different savings options
Understands how to protect savings against the effect of inflation
Overall financial literacy score
Regression estimate of financial literacy relative to high school dropouts
Distribution of correct responses
High school dropout
Some postsecondary education
Terminal high school diploma
University graduate

Notes: This chart shows the distribution of correct responses to several questions about financial literacy, which were posed to respondents to the 2009 Canadian Financial Capability Survey. In total, 14 questions were asked, the details of which are discussed by K. Mullock and J. Turcotte, 2012, *Financial Literacy and Retirement Saving*. The measures of individuals' understanding of the effects of inflation, type of taxation charged on taxable savings, relative risks of savings options, and ways to protect against the effects of inflation are based on responses to questions 1, 6, 8 and 9 of the financial literacy component of this survey, respectively. Overall financial literacy is the percentage of correct responses to all 14 questions. The regression estimates of the effects of education are normalized relative to the actual overall financial literacy score of high school dropouts. Following M. Frenette, 2014*b*, *The Long-term Labour Market Premiums Associated with a Terminal High School Diploma*, individuals with a terminal high school diploma are defined as those who had obtained a high school diploma but had not acquired any postsecondary education by the 1991 Census or the 2006 Census.
Source: Statistics Canada, 2009 Canadian Financial Capability Survey.

The results of this regression are presented in the last grouping of Chart 3, where each coefficient estimate is normalized relative to the average overall financial literacy score of high school dropouts. Importantly, the observed gains from education are not absorbed by controlling linearly for a wide array of personal and family characteristics that are expected to influence financial literacy.

4 The effect of education on savings rates

This section estimates the effect of compelling individuals to complete high school on their savings rates in tax-preferred accounts over the life cycle. Following Oreopoulos (2006; 2007) and the related literature on the returns to education cited above, historical reforms to compulsory schooling laws across provinces are used for exogenous variation in educational attainment to identify this effect, using an IV framework.

4.1 Exogenous variation in education

The effect of compulsory schooling laws on the likelihood of completing high school is estimated in the following statistical model:[8]

$$CompletedHS_{icp} = \eta + CS'_{cp}\theta + I'_{cp}\kappa + \overline{Z}_{icp}\lambda + \sum_p \xi^p \left\{1\left(P_{ipc} = p\right) \times c\right\} + \mu_{icp}. \quad (2)$$

In Equation (2), the dependent variable $CompletedHS_{icp}$ indicates whether individual i from cohort c (by year of birth) and born in province p obtained at least a high school education (see Footnote 7 for a discussion of this classification). The function $1(.)$ is an indicator that returns the value "1" if its argument is true and "0" otherwise. Hence, based on the notation from Section 3, the dependent variable is calculated as follows:

$$CompletedHS_{icp} \equiv 1\left(HSGrad_{icp} = 1 \text{ or } SomePSE_{icp} = 1 \text{ or } UnivGrad_{icp} = 1\right). \quad (3)$$

The right-hand side variables of Equation (2) are defined as follows. First, CS_{cp} reflects compulsory schooling laws that were in effect in province p for cohort c. This measure includes both the legal entry age into primary school and the legal dropout age in high school.[9,10] Second, I_{cp} is a vector of other institutional factors that vary across cohorts and provinces that may explain differences in high school completion rates, namely whether exemptions were permitted and provincial school board expenditures.[11] Third, Z_{icp} is a vector of individual covariates, including: a cubic polynomial in age; sex, marital status, and province of residence; union dues, labour income, and other income; disability tax allowances; sector of employment; and home value. The census variables—namely, education and home value—are only available cross-sectionally, whereas the administrative data are longitudinal from 1991 to 2010. To combine these two data sources to estimate Equation (2), $\overline{Z}_{icp}$ is constructed using individuals' province of residence and sector of employment corresponding to the year in which they appear in the census. The remaining variables (except sex, which is time-invariant) are averages of Z_{icp} for each individual across all observed years, adjusted for inflation where appropriate. Fourth, P_{icp} is an indicator of

8. This analysis focuses on high school completion as the outcome of interest because compulsory schooling reforms are binding for lower levels of educational attainment. While prior studies have estimated the effect of compulsion on the total number of years in school, this variable is not available in both the 1991 and 2006 Census.
9. As in most of the related literature cited above, individuals are matched to the entry age in effect in their province of birth when they were 6 years old and to the dropout age in effect when they were 14 years old.
10. Based on the sample selection criteria described in Section 2, this analysis effectively exploits variation in entry ages that occurred from 1938 to 1992 and variation in dropout ages that occurred from 1946 to 2000. Most prior studies on the returns to education cited above exploit a wider range of reforms, but doing so here would require a linkage file between administrative records and an earlier census, which is not available.
11. For more information on the compulsory schooling or exemptions variables, see Oreopoulos (2006). The data for school expenditures are obtained from CANSIM table 478-0012 (Statistics Canada n.d.) and are expressed here in thousands of 2010 constant dollars.

the individual's province of birth; ξ^p estimates a linear cohort trend specific to province p to control for unobserved factors within provinces that change over time and affect high school completion rates (Stephens and Yang 2014). Fifth, the term μ_{icp} is a statistical residual that includes cohort and province-of-birth fixed effects.[12]

The results from Equation (2) are shown in Table 2. In particular, three different approaches to account for compulsory schooling laws are used. The first approach is to estimate how a vector of indicators for the entry and dropout ages applied to each individual affects high school completion. The second approach is to estimate the average direct effects of changing the entry and dropout ages by one year on high school completion. Defining the minimum number of mandatory years in school as the difference between the entry and dropout ages, the third approach is to estimate how a change in mandatory years affects high school completion. In the first two cases, the analysis indicates that lowering the entry age or raising the dropout age both increase the likelihood of obtaining a high school diploma. The third approach finds that compelling individuals to stay in school an extra year raises the likelihood of graduating by approximately 1 percentage point. While the magnitude of this effect is smaller than estimates from related studies, the point estimate is statistically significant and economically meaningful. Given the sample-selection criteria used in this study and the labour-market-based approach for ranking educational attainment (see Footnote 7), approximately 82.5% of the sample has completed high school, so an extra mandated year in school reduces the non-completion rate by 5.7%. As Table 2 shows, this result is robust to controlling for a wide array of individual-specific covariates; hence, CS_{cp} is a plausible excluded instrument for estimating how education affects savings behaviour over the life cycle.

12. The age variable is identified separately from the cohort and survey-year fixed effects because different individuals from the same cohort are observed a different number of times in the longitudinal data. Controlling for the average ages of individuals in the sample is important for analyzing savings behaviour.

Table 2
First-stage effects of compulsory schooling on high school completion

Type of compulsory schooling controls in the estimator	Entry and dropout age fixed effects	Entry versus dropout age effects	Effect of total mandatory years	Effect of total mandatory years (all controls)
		coefficient estimates		
Fixed effects				
Entry age = 7	0.010	...	...	...
Entry age = 8	-0.029 ***	...	...	...
Dropout age = 15	0.003	...	...	...
Dropout age = 16	0.013 *	...	...	...
Dropout age = 18	0.028 **	...	...	...
Linear effects				
Entry age	...	-0.013 ***	...	...
Dropout age	...	0.008 **	...	...
Combined effect				
Mandatory years	...	...	0.010 ***	0.010 ***
Additional controls				
Age fixed effects	yes	yes	yes	yes
Cohort fixed effects	yes	yes	yes	yes
Birth-province fixed effects	yes	yes	yes	yes
Birth province–cohort trends	yes	yes	yes	yes
Institutional covariates	yes	yes	yes	yes
Individual covariates	no	no	no	yes
Labour income controls	no	no	no	yes
Labour income 10-piece spline	no	no	no	yes
		estimates		
Statistics				
R-squared	0.042	0.041	0.041	0.118
F-test of excluded instruments	11.080 ***	15.180 ***	26.730 ***	26.540 ***
		number		
Observations	477,813	477,813	477,813	473,608

... not applicable

* significantly different from reference category ($p < 0.05$)

** significantly different from reference category ($p < 0.01$)

*** significantly different from reference category ($p < 0.001$)

Notes: The first column shows the estimated effects of compulsory schooling on the incidence of completing high school using ordinary least squares, controlling for compulsion using a vector of fixed effects for the entry and dropout ages. The second column estimates the linear average effects of per-unit changes in the entry and dropout ages on completion. The third and fourth columns estimate the average effect of a per-unit change in the minimum number of mandatory years in school on completion. "Mandatory years" is defined as the difference between the entry and dropout ages. The compulsory schooling data are from P. Oreopoulos, 2006, "The compelling effects of compulsory schooling: Evidence from Canada." Institutional covariates include an indicator of whether exemptions were permitted and provincial school-board expenditures. The labour income controls are the average value of labour income for each individual observed for all years and the variance in labour income observed for each individual over time. The F-test of excluded instruments shows the joint significance of the variables for entry and dropout ages and for mandatory years on high school completion, conditional on all other variables being included in the model.

Sources: Statistics Canada, Longitudinal Worker File—1991 Census and T1 Personal Master File—2006 Census—2011 National Household Survey.

4.2 Returns to education

The effect of high school completion on individuals' savings rates in tax-preferred accounts is estimated in the following statistical model:

$$\overline{sr}_{icp} = \iota + \pi CompletedHS_{icp} + I'_{cp}\chi + \overline{Z}_{icp}\omega + \sum_p \psi^p \left\{1\left(P_{ipc} = p\right) \times c\right\} + \nu_{icp}. \quad (4)$$

In this case, the dependent variable is the individual's savings rate (averaged over all observed years), defined in Section 3. Equations (2) and (4) are estimated in a two-stage least squares (2SLS) framework.

The second-stage results of the 2SLS estimator are shown in Table 3. In particular, high school completion has a significant, robust effect on savings rates, even after controlling for a wide set of channels—including employment, income, health, and permanent income—through which education may indirectly affect such behaviour.[13] The preferred model specification (the fourth column, which controls for the largest set of covariates) indicates that completing high school raises individuals' savings rates by an average of 6.4 percentage points. Note that, while the ordinary least squares (OLS) estimate predicts that completing high school raises savings rates by an average of only 2.1 percentage points, the IV estimator is less precise than OLS. The lower bound on the 95% confidence interval from the preferred IV regression is 1.3. On this basis, high school completion appears to boost retirement savings rates by approximately 2 to 6 percentage points, consistent with the graphical inspection in Chart 1.

13. Given that the income measure used is an average over all observed years, this amounts to controlling for permanent income. The results are robust to controlling very flexibly for permanent income using a 10-piece spline. In addition, as the note in Table 3 mentions, the variance in labour income over time for each individual is also included as a labour income control variable to account for the fact that individuals with different levels of uncertainty about income are likely to save differently for retirement.

Table 3
Second-stage effects of educational attainment on savings rates

	Instrumental variables				Ordinary least squares
	coefficient estimates				
Estimator					
Completed high school	0.093 **	0.073 **	0.074 **	0.064 *	0.021 ***
Additional controls					
Age fixed effects	yes	yes	yes	yes	yes
Cohort fixed effects	yes	yes	yes	yes	yes
Birth-province fixed effects	yes	yes	yes	yes	yes
Birth province–cohort trends	yes	yes	yes	yes	yes
Institutional covariates	yes	yes	yes	yes	yes
Individual covariates	no	yes	yes	yes	yes
Labour income controls	no	no	yes	yes	yes
Labour income 10-piece spline	no	no	no	yes	yes
			estimates		
Statistics					
R-squared	0.052	0.285	0.293	0.345	0.412
F-test of excluded instruments	26.730 ***	30.280 ***	27.720 ***	26.540 ***	...
			number		
Observations	477,813	477,475	473,608	473,608	473,608

... not applicable
* significantly different from reference category ($p < 0.05$)
** significantly different from reference category ($p < 0.01$)
*** significantly different from reference category ($p < 0.001$)
Notes: The first four columns show the estimated effect of completing high school on savings rates in tax-preferred accounts using a two-stage least squares estimator, with mandatory years in school serving as the excluded instrumental variable, where each column controls for different observed factors. The last column shows the estimated effect of completing high school on savings rates in tax-preferred accounts using ordinary least squares. Institutional covariates include an indicator of whether exemptions were permitted and provincial school-board expenditures. The labour income controls are the average value of labour income for each individual observed for all years and the variance in labour income observed for each individual over time. The F-test of excluded instruments shows the significance of the variable for mandatory years on high school completion from the first-stage regressions, conditional on all other variables being included in the model.
Sources: Statistics Canada, Longitudinal Worker File–1991 Census and T1 Personal Master File–2006 Census–2011 National Household Survey.

5 The effect of education on savings adjustments

While the previous section found that education has a sizeable effect on retirement savings, a limitation of that analysis is that controlling for **every** indirect channel through which schooling affects savings levels is not possible. For example, individuals who obtain more schooling may expect to live longer and, therefore, have greater demand for retirement wealth, biasing the estimated returns to education upward. To control for such effects, the regression analyses did include a disability tax allowance variable, although this is an imperfect measure of health. For this reason, it is instructive to consider how educational attainment also influences a different type of savings decision: how individuals adjust (or re-optimize) savings rates in response to a nudge, defined herein as an automatic change in wealth accumulation within RPPs.

5.1 Savings nudge

Most RPPs have contribution and/or benefit schedules that are integrated with the contribution schedule of the CPP and the QPP. This workplace pension feature exists because firms recognize the added costs imposed on them by the public pension, and offset such costs by setting lower marginal rates for RPP contributions and/or benefit accruals on income that is charged more heavily by the CPP and the QPP, and vice versa. Further details on this integration feature of RPPs are provided by Frenken (1996) and Statistics Canada (1996, 2003). Importantly, since integration is decided at the firm level, this change in RPP contributions is plausibly **exogenous** from the workers' perspective.[14]

As Messacar (2015) shows, integration means that a typical employer's RPP contribution schedule **kinks** upward at the average industrial wage. In a two-stage regression kink design (RKD), both the first-stage effect of integration on RPP contributions and the second-stage crowd-out effect on RRSP contributions can be estimated simultaneously. The statistical model is as follows:

$$RPP_{it} = \tau_0 + \rho_0(Y_{it} - T_t) + \upsilon_0(Y_{it} - T_t)D_{it} + Z_{it}'\phi_0 + \sigma_{it} \tag{5}$$

$$RRSP_{it} = \tau_1 + \rho_1(Y_{it} - T_t) + \upsilon_1(Y_{it} - T_t)D_{it} + Z_{it}'\phi_1 + \varsigma_{it}. \tag{6}$$

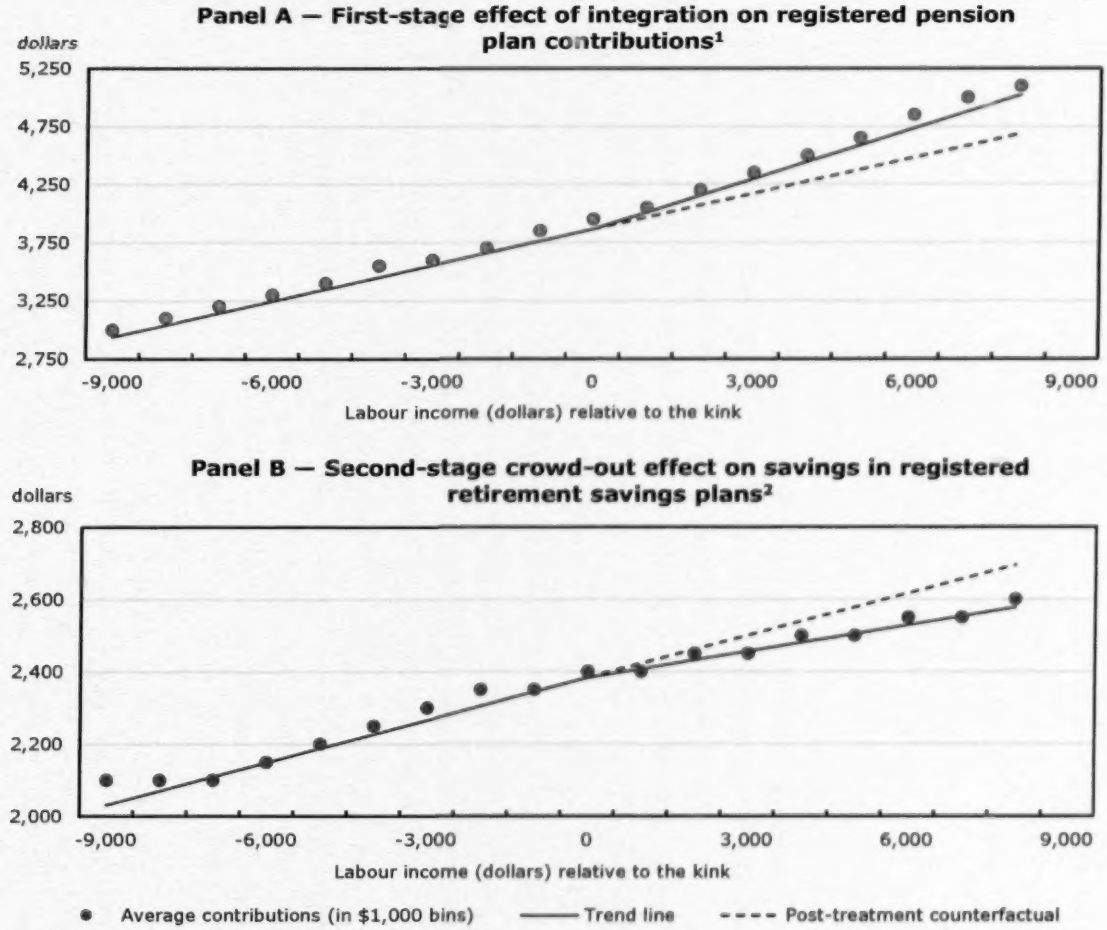
The model is estimated conditional on $(Y_{it} - T_t) \in [-B, B]$, where B is the bandwidth. The dependent variables RPP_{it} and $RRSP_{it}$ are individual i's contributions to RPPs and RRSPs in year t, respectively. The time period considered is from 1991 to 2010. The variable Y_{it} is the individual's labour income, and Z_{it} is a vector of the following covariates: age, sex, marital status, province of residence, and year fixed effects; sector of employment; other income; and disability tax allowances. $D_{it} = 1(Y_{it} \geq T_t)$ is an indicator of whether labour income exceeds the average industrial wage at time t, denoted as T_t. Since the widest bandwidth used in Messacar (2015) is $B = \$9,000$, this bandwidth is used again here to provide as much power to the estimator as possible.[15] In addition, the sample is restricted to workers with strictly positive contributions in both RPPs and RRSPs—for whom substitution is possible—but whose combined savings do not exceed their contribution limits—so that any displacement effect is not driven by the tax treatment of these plans. From Equations (5) and (6), the crowd-out parameter of interest is $\upsilon = \upsilon_1 / \upsilon_0$. Both equations are estimated together as seemingly unrelated regressions, and standard errors (clustered by individual) for the crowd-out parameter are calculated using the Delta method.

14. This automatic change in pension wealth accumulation can be interpreted as a "natural" experiment of the savings rate escalator studied by Thaler and Benartzi (2004) in a controlled setting. For this reason, the type of variation analyzed in this study fits well within the nudge paradigm of Thaler and Sunstein (2008).
15. There are several assumptions and tests that must be satisfied for the RKD to be valid. These issues are discussed and evaluated in Messacar (2015), and are not repeated here for compactness. Readers may refer to this prior study for further details. For reasons discussed in this prior study, the RKD analysis is restricted to workers who are unionized.

5.2 Results

Graphical depictions of Equations (5) and (6) are shown in Chart 4. More precisely, Panel A plots the average values of RPP contributions in $1,000 bins relative to labour income normalized by the average industrial wage. The simple RKD regression (not controlling for covariates Z_{it}) is also shown. The RPP contribution schedule is an increasing function of income, the pre-treatment savings rate being estimated at 10.3%. This savings rate includes both employer and employee contributions, although, as Messacar (2015) shows, the treatment effect of integration operates through the employer's share. The RKD estimate indicates that RPP contributions increase by $0.04 on income above the average industrial wage, which is a 40.8% increase over the pre-treatment savings rate. Similarly, Panel B shows that the RRSP savings rate before treatment is 3.9%, but that contributions fall by slightly less than $0.02 on income above the average industrial wage. Thus, a savings nudge of $1.00 in RPPs crowds out RRSP contributions by approximately $0.35, on average.

Chart 4
Graphical inspection of crowd-out



1. Panel A: Estimate of pre-treatment slope = 0.103 ($p < 0.001$); kink estimate = 0.042 ($p < 0.001$).
2. Panel B: Estimate of pre-treatment slope = 0.039 ($p < 0.001$); kink estimate = -0.015 ($p < 0.001$); crowd-out estimate = 0.349 ($p < 0.001$).

Notes: Panel A shows contributions to registered pension plans (RPPs) as a function of labour income normalized to the average industrial wage. Panel B shows contributions to registered retirement savings plans (RRSPs) as a function of labour income normalized to the average industrial wage. Each data point corresponds to the average contribution in bin widths of $1,000. The simple regression estimates (not controlling for covariates) of the slopes of the savings functions and the magnitudes of the kinks at the average industrial wage are also reported, where standard errors are clustered by individual. The crowd-out estimate is obtained by dividing the (absolute) value of the kink in RRSP contributions by the kink in RPP contributions, and the standard errors are calculated using the Delta method.

Sources: Statistics Canada, Longitudinal Worker File–1991 Census and T1 Personal Master File–2006 Census–2011 National Household Survey.

To explore this finding in more detail, the first column of Table 4 estimates Equations (5) and (6) while controlling for the observed covariates, Z_{it}. These results show that a $1.00 nudge in RPPs displaces contributions in RRSPs by approximately $0.53, indicating that workers partially substitute between these two types of accounts. The table also shows how workers' savings adjustments vary by level of schooling. Specifically, high school dropouts exhibit low crowd-out relative to workers who have completed high school, suggesting that under-responsiveness is to some extent explained by educational attainment. To control for the possibility that workers' educational attainment and savings responses may be correlated for unobserved reasons—such as attentiveness—this analysis is repeated using a **predicted** measure of high school completion using the regression estimates from Equation (2), exploiting the compulsory schooling reforms in the identification. However, these results continue to suggest that less-educated workers under-respond to a savings nudge as compared to more-educated workers. In addition, conditioning on individuals who reported having some post-secondary or a university degree, the table shows that he magnitude of crowd-out continues to increase with educational attainment.

Table 4

Regression-based estimates of crowd-out to a savings nudge, by educational attainment

		Actual education		Predicted education		Other levels of actual education	
Sample selection (group)	Full sample	High school dropout	Completed high school	High school dropout	Completed high school	Has trade certificate	University graduate
				estimates			
RPP contributions							
Slope estimate	0.109 ***	0.087 ***	0.110 ***	0.100 ***	0.101 ***	0.108 ***	0.104 ***
Kink estimate	0.033 ***	0.045 ***	0.032 ***	0.020 *	0.034 ***	0.036 ***	0.043 ***
RRSP contributions							
Slope estimate	0.047 ***	0.054 ***	0.046 ***	0.052 ***	0.047 ***	0.045 ***	0.042 ***
Kink estimate	-0.018 ***	-0.005	-0.018 ***	-0.002	-0.019 ***	-0.022 ***	-0.030 ***
Crowd-out							
Crowd-out estimate	0.529 ***	0.119	0.572 ***	0.090	0.558 ***	0.619 ***	0.685 ***
				number			
Statistics							
Individuals	58,967	5,729	53,281	7,291	51,767	42,682	15,960
Observations	214,276	21,933	192,343	24,278	189,998	148,012	45,686

* significantly different from reference category ($p < 0.05$)

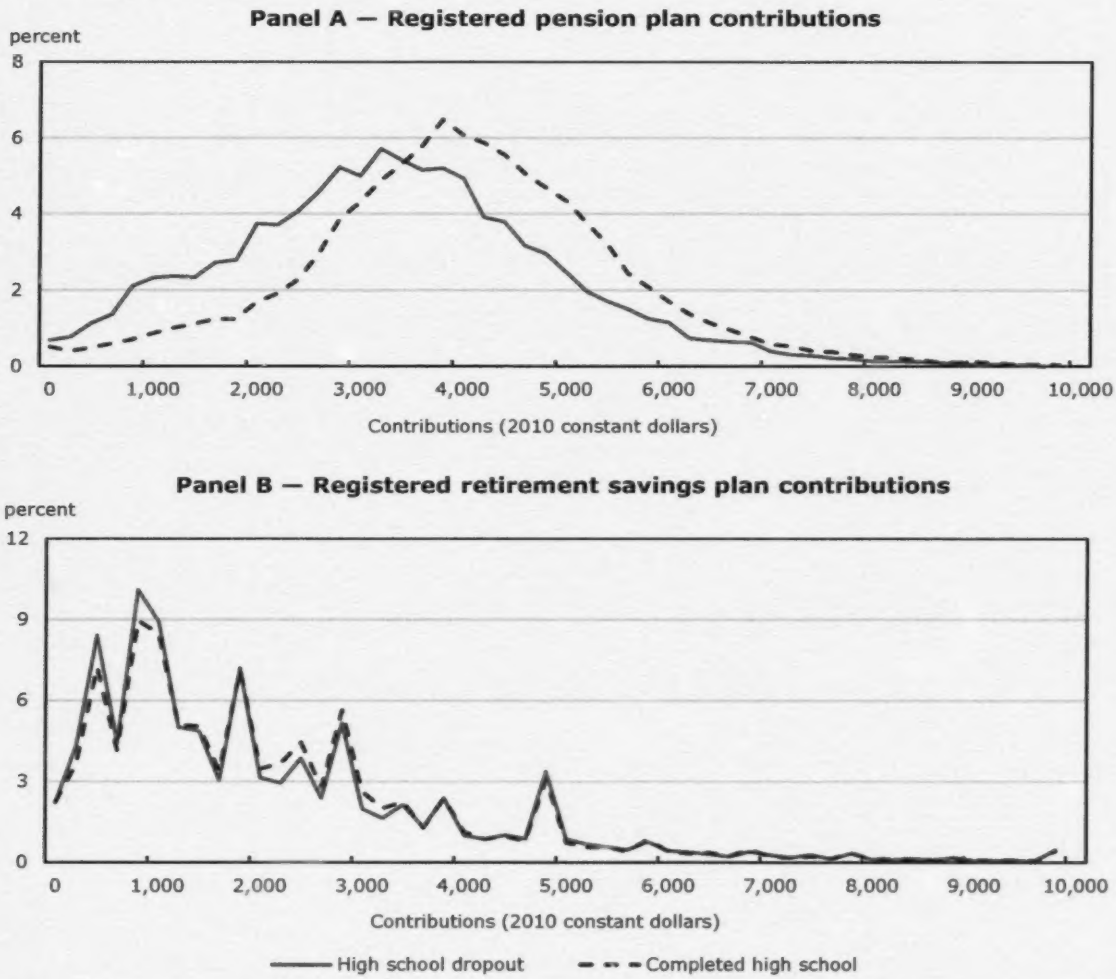
*** significantly different from reference category ($p < 0.001$)

Notes: The regression estimates of contributions to registered pension plans (RPPs) and registered retirement savings plans (RRSPs) as functions of labour income normalized to the average industrial wage are shown in this table. The estimated kinks in RPP and RRSP contributions at the average industrial wage level are also shown. The RPP and RRSP contribution schedules are estimated jointly as seemingly unrelated regressions; the crowd-out estimate is obtained by dividing the (absolute) value of the kink in RRSP contributions by the kink in RPP contributions, and the standard errors are calculated using the Delta method.

Sources: Statistics Canada, Longitudinal Worker File—1991 Census and T1 Personal Master File—2006 Census—2011 National Household Survey.

An alternative explanation for the lack of crowd-out among workers with lower levels of education is that they save infrequently in non-workplace accounts and are, therefore, relatively constrained in their ability to respond to a nudge. While the RKD analysis conditions on individuals with strictly positive savings in both RPPs and RRSPs to address this issue, some further investigation is still warranted. To that end, Panels A and B in Chart 5 plot the distributions of RPP and RRSP contributions, respectively, for workers who appear in the RKD sample. The workers who completed high school tend to save slightly more in RPPs than high school dropouts, but the distributions of RRSP contributions for both groups nearly perfectly overlap. Hence, both groups have the same financial capacity to respond to a savings nudge. The similarity in savings behaviour despite such underlying differences in educational attainment may stem from the fact that the RKD imposes a degree of homogeneity on the sample, given that estimates are localized around the average industrial wage. How these results generalize to all workers across the full income distribution is, for methodological reasons, outside the scope of this study.

Chart 5
Distributions of savings in tax-preferred accounts among the sample of workers in the crowd-out analysis, by educational attainment



Notes: Panel A shows the distributions of contributions to registered pension plans from $1 to $10,000 among individuals in the crowd-out analysis, by educational attainment. Panel B shows the distributions of registered retirement savings plan contributions, by educational attainment. Consistent with the crowd-out analysis, high school completion refers to obtaining at least a high school diploma, based on the market-based ranking of educational attainment in the 1991 and 2006 censuses.

Sources: Statistics Canada, Longitudinal Worker File–1991 Census and T1 Personal Master File–2006 Census–2011 National Household Survey.

6 Conclusion

This paper provides new insight into the long-reaching effects of education on the retirement savings behaviour of Canadians. Using two unique datasets that combine annual administrative tax data with responses to the 1991 and 2006 censuses, and exploiting compulsory schooling reforms in the identification, the results indicate that completing high school may boost retirement savings rates in registered pension plans (RPPs) and registered retirement savings plans (RRSPs) by approximately 2 to 6 percentage points, on average, annually over the life cycle—even after controlling for income and other observed factors that may indirectly affect this result. In addition, workers with higher levels of education respond actively to a nudge in RPPs by reducing RRSP contributions, whereas those with lower levels of education are passive to the distortion. One possible explanation for these findings is that educational attainment and financial literacy are correlated.

Taken together, these findings suggest that workers with lower levels of education save less than those with higher levels of education but benefit from a nudge by remaining passive—for them, the nudge raises total retirement savings—whereas workers with higher levels of education substitute between RPPs and RRSPs at low cost. This finding fits well within the nudge paradigm of Thaler and Sunstein (2008), since it provides new insight into the cognitive mechanisms behind why a nudge works. Specifically, active versus passive choice is to some extent determined by human-capital characteristics. There is a growing literature in behavioural economics that finds default options, savings rate escalators, and other types of nudges to be effective mechanisms for increasing retirement wealth accumulation (Madrian and Shea 2001; Choi et al. 2004; Thaler and Benartzi 2004; Chetty et al. 2014). The findings from this study are consistent with the related literature—total retirement savings partially increase. However, the analysis of education suggests that programs aimed at improving cognition, human capital or financial literacy may be imperfect substitutes for nudging. More schooling reduces the need for a nudge—as individuals save more for retirement on their own—and also mitigates the effectiveness of a nudge—as savers become more active and offset the savings distortion by reducing their contributions in other retirement accounts. The efficient mix of policies that nudge, educate, and simplify choice (Choi, Laibson and Madrian 2011; Beshears et al. 2013) is an interesting topic for future research.

To conclude, it is important to mention that this study's crowd-out analysis centres on workers who have savings in both RPPs and RRSPs in a given year. For these workers, the automatic RPP contribution is a "nudge" because they have the capacity to opt out by reducing their levels of saving in RRSPs. A growing literature in behavioural economics investigates the social welfare implications of nudging, but a consensus has not been reached and depends in part on whether a role for paternalism is subsumed (Bernheim and Rangel 2009; Carroll et al. 2009; Chetty et al. 2014; Bernheim, Fradkin and Popov 2015). However, only approximately half of RPP members make contributions to RRSPs in a given year (Messacar 2015); for the other half, adjustments along other margins may be possible—such as in taxable accounts—but the automatic RPP contribution may also constitute "forced" or mandatory savings for this group. The welfare implications in this case are even less clear; for example, as Whitehouse (2013) notes, the costs of inducing some individuals to over-save can be as great as the consumption losses to others in retirement from saving myopically.

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